THE FLORA AND FAUNA OF NUYTS ARCHIPELAGO AND THE INVESTIGATOR GROUP.

No. 8.—THE ECOLOGY OF PEARSON ISLANDS.

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Plates IV. to IX.

The following account of the ecology of Pearson Islands is based on observations made during a stay on North Pearson from January 5 to 12 of this year. I desire to express my thanks to Prof. F. Wood Jones, leader of the party, for assistance in various ways, and to Mr. T. D. Campbell, for permission to make use of his sketch map of the islands in constructing text fig. 1.

The party is indebted to Sir G. J. R. Murray, K.C.M.G., for a generous donation towards the cost of the expedition.

Pearson Islands lie in lat. 33° 58′ S., long. 134° 15′ E., at a distance of about 40 miles from the nearest mainland, the west coast of Eyre Peninsula, South Australia. They are, however, only 18 miles south-west from Flinders Island, a comparatively large island, the area of which is 9,000 acres. They are the south-western islands of the Investigator group, and were named by Matthew Flinders in 1802, but were not visited by him. Robert Brown, who was naturalist on board H.M.S. "Investigator," did not, therefore, land upon them, and, as the islands are uninhabited, with a rather uncertain landing, it is improbable that they have been visited by a botanist before.

According to the Australia Directory[1] the Pearson group consists of four islands and a rock partly above water. This paper refers only to the North Island of the Directory, which is the largest and most important. No landing could be made on any of the other islands. Two of them are too precipitous for any landing, though one might be effected upon the third. A careful examination of the vegetation upon them by means of field glasses indicates that the flora is of the same type as on the more exposed parts of North Island. These outlying islands will not be referred to again in this account.

PHYSIOGRAPHIC FEATURES.

The North Island of the Australia Directory consists of two, or, for descriptive purposes, preferably three land masses lying close together (text fig. 1). The southern land mass is connected with the middle one by an isthmus of bare granite boulders, which is above high-tide mark, but would in storms be entirely spray drenched. The northern land mass, which is the largest, being about 1½ miles long by 1½ miles broad, is separated from the middle one by a strait about 100 yards across, and can only be reached by wading at low tide in calm weather. In the following account the North Island of the Australia Directory will be spoken of as if it were three separate islands, called respectively Northern, Middle, and Southern. The group consists of exceedingly bold, rugged, granite islands rising in one place on Northern Island 781 feet[2] above sea level. The

[1] Australia Directory, 10th Edition, p. 169, 1907.

[2] The altitudes are taken from the Hydrographic Survey, Australia Directory, *loc. cit.*

granite comes as sheer cliff, jumbled boulder, or sloping pavement to the sea on all sides except for a small sandy beach, the landing place, on the east side of Middle Island. The south and west faces of the islands are most rugged, and in places precipitous cliffs rise 200 feet or more. The ocean swell of the Great

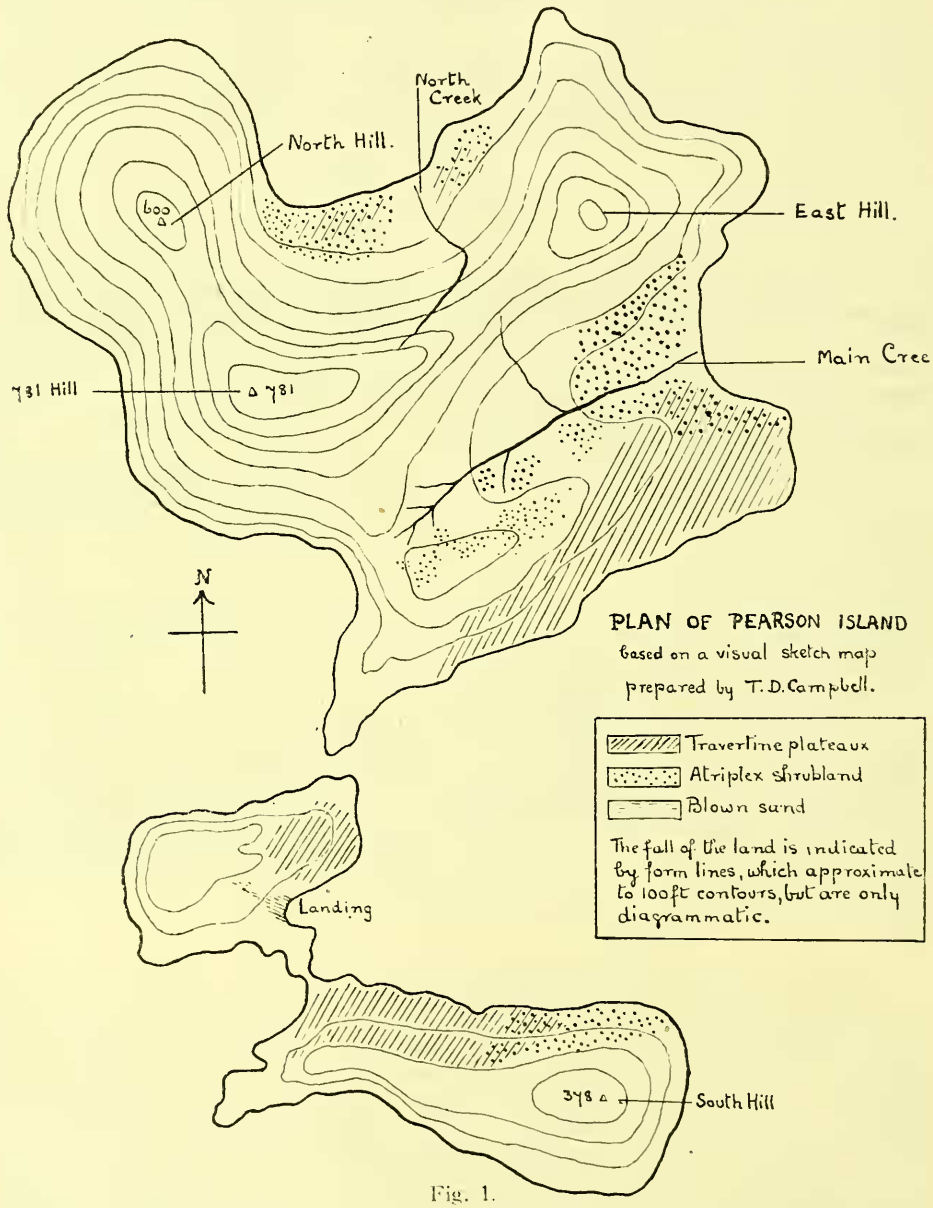

Fig. 1.

Australian Bight, driven by moderate winds, dashes with great force against these walls, sending spray high in the air. In rough weather and in winter the seas must be very heavy, and the spray be carried by the gales for some distance inland. This is seen by the occurrence of such halophytes as *Arthrocnemum* and *Suaeda* 200 to 300 feet above sea level.

Northern Island is divided into two unequal portions by a watercourse running roughly south-west to north-east, hereafter called Main Creek. To the north of this are three bold granite summits. The highest lies above the head of the creek, rising 781 feet, and called 781 Hill. This is connected with the two other peaks, each about 600 feet high, by necks of high land. The eastern, East Hill, rises above the mouth of Main Creek, with only a narrow col, that in places is a bare granite ridge 3 or 4 yards across, connecting it with 781 Hill. Between North and East Hills is a beautiful sheltered bay, the shore of which is bare granite. North Hill and its neck rise precipitously from the shore of this bay, but the slopes of East Hill and the col to 781 Hill rise more gradually with an interesting talus slope that is traversed by a torrent bed (North Creek) draining from 781 Hill. Between 781 and East Hills is another watercourse draining the south side. This creek has a less precipitous bed; it is a tributary of Main Creek.

Granite tors and boulders occur on most of the hilltops and exposed slopes of these islands (pl. iv., fig. 2), but 781 and North Hills are remarkable for the large slopes of bare granite that occur even upon their sheltered faces (pl. iv., fig. 2, and pl. vi., fig. 2). These bare rocks are even expanses, in some cases over an acre in extent. Some are precipitous, but many slope at only a low angle and then end abruptly with a cliff 6 to 10 feet high. They are generally without any vegetation except for algae that mark the watercourses across them. The dark olive-green or black of these lines is in striking contrast to the grey-brown of the granite rock. Such slopes serve as huge catchment areas from which there is an immediate run off. The ground at their lower edge, however, has a low water-holding capacity, and the drainage water falling on it serves rather to leach soluble salts out of it than to increase its fertility. The soil immediately below these slopes, then, is often coarser and more barren than is that further away.

The southern portion of the Northern Island has no striking physiographic features. Its western end has bold granite tors; towards the eastern end it slopes gradually to the sea. Much of the area is a travertine limestone plateau.

Middle Island (pl. viii., fig. 2) has a much smaller area, consisting of a low summit, estimated at somewhat over 200 feet high on the west side, and falling precipitously to the sea. The fall is more gradual on the east side with talus slopes that spread as a fan upon a small travertine plateau. This latter occupies about a quarter of the area of the island. At the south side of this island is the small sandy beach that forms the only landing place on the group. The sand is limited to a patch about 50 yards square, though some—blown from the beach—lodges in the cracks of the granite slopes lying immediately behind.

Southern Island has two peaks, one a mere collection of bare tors; the other, South Hill, near its south-east point, is 378 feet high. The two peaks are connected by a ridge, the exposed southern face of which is a sheer precipice nearly 200 feet high. The coast, immediately below South Hill, is a sloping pavement of granite swept bare by waves for over 100 feet. Southern Island also has its travertine plateau, occupying almost a third of its area.

Travertine Limestone.

The travertine plateaux are a striking feature of the three islands. From the sea they are at once recognizable by their more level appearance and the different colour of the vegetation they support. The travertine limestone lies near the surface of the soil, but is usually exposed only at the cliff faces. The overlying soil and underlying rock are obviously of granitic origin, more or less cemented in the underlying portion by limestone. Shells of a land-dwelling

gasteropod occur in a subfossil state in the consolidated rubble below the limestone bed. Professor W. Howchin has kindly determined these shells as *Bothriembryon mastersi*, Cox. Professor F. Wood Jones informs me that similar shells in a living state occur on the surface of the islands to-day. As travertine is a very recent or modern geological formation, the occurrence of a living species in a subfossil state is not surprising. The travertine limestone that is now present overlying the granite is probably only the remains of what was once a thick deposit of calcareous sand. This has now been eroded, leaving the limestone as an indication of its former presence.

The islands of the West Coast are the remains of the old coast of South Australia that, during the Pleistocene period, was south and west of its present line. The islands and neighbouring portions of the mainland consist of indurated sands resting upon a platform of older rocks. This platform is generally a few feet above or below sea level. It represents, according to Howchin,[3] who has examined the structure of the islands and mainland eastward of Cape Catastrophe, a base level of erosion, probably marine. At some post-Miocene time this platform became covered by calcareous sands left by the sea in its line of retreat. Huge dunes must have been formed, for some of the islands, *e.g.*, Thistle Island, show a thickness of sand over 700 feet. Still more recently the sea returned and is now wasting away the soft wind-constructed sand left in the line of its former retreat.

There is no reason to doubt that the area which is now Pearson Islands received a deposit of calcareous sand, but it is open to question whether this deposit was continuous over its highest parts. No travertine was found on the hillsides above 200 feet. The opinion is expressed that even at the period of maximum sand covering, the present hilltops (at least, of Pearson Islands), projected as granite outcrops. Such granite outcrops are common on the mainland in Central Eyre Peninsula to-day, and they bear a flora which is different in constitution from that of the porous sandy soil around them. Certain of the plants found on Pearson Island are of this "granite-outcrop" type of flora rather than sand dune. The occurrence of a rock wallaby *(Petrogale pearsoni)* that is unknown on the mainland, also indicates that a rocky outcrop has been a feature of the Pearson area for a great length of time.

ENVIRONMENTAL FEATURES.

I. Climatic.

Rainfall and temperature data were given in a previous paper on the Franklin Islands[4] for the two nearest meteorological stations on the mainland. These lie to the north of the Pearson group, so that they represent a more extreme type of climate than that existing there, especially as the Pearsons are islands lying well out in the open sea. The general climatic conditions, shown in the table for Franklin Island, of winter rainfall and a dry summer, with probably one or two completely rainless months, will therefore hold for Pearson Islands. The temperatures are likely to show a smaller range, days of over 100° F. or more in the shade are unlikely, as are frosts. No more positive data than those cited can be given, but observations made during a week's stay on the islands suggest some additional features of the climate.

The prevalent winds are south-west, and are often of great strength. Shearing action by the winds is well shown by shrubs exposed to their violence. The most striking examples occurred at the head of Main Creek. There the trees of *Melaleuca halmaturorum* have a prostrate habit (pl. iv., fig 2). One old tree measuring 24 feet in length and 8 inches in diameter at the base is growing

[3] Howchin, W., Proc. Roy. Geogr. Soc. S. Austr., x., pp. 204-219, 1908.

[4] Osborn, T. G. B., *loc. cit.*, p. 197.

quite flat upon the ground, and the foliage, which is confined to the terminal branches, is spread as a bushy carpet.

The presence of three peaks—600 feet high or over—upon North Island causes raincloud or mist to hang about the higher levels to a considerable degree. Thus, on the morning of our landing there was light rain about 6 a.m., and the peaks were blotted out by clouds. These gradually lifted as the sun rose, but they hung about the top 200 feet or so of 781 Hill until nearly 11 a.m. In winter this cloud effect must be considerable. The ground flora at and just below the summit of 781 Hill includes several mosses, and the fern *Cheilanthes tenuifolia* suggesting a greater humidity than lower down the slopes or even along the water courses.

The insolation factor upon the islands must be very severe, and aspect differences between north or west slopes and south or east are marked. The two former are much drier and the rock weathers more rapidly than in the case of the latter. This is particularly well seen in the case of East Hill when viewed from the col connecting it with 781 Hill (pl. iv., fig. 1). The north face has precipitous granite tors and rocky slopes supporting an open flora of shrubs; this extends almost to the summit. On the south face the angle of the slope is lower with less bare rock. *Casuarina* woodland, which is the climax community on hill summits, extends down the slope for some distance on the south side, and when it passes into scrub communities the latter are thicker and less open.

II. Edaphic.

In Appendix I. Mr. J. G. Wood gives the results of certain analyses made of soil samples collected upon the islands. There are three soil types on the Pearsons—blown sand, travertine, and granitic.

The first, as described above, is limited to a small patch at the south end of Middle Island near the landing place. It need not be considered further.

The travertine soils consist of a coarse granitic sand mingled with particles of limestone of all sizes from small fragments to large blocks several square feet in area. The soil appears to dry out very thoroughly; in January there was no cohesiveness between the particles at a depth of 8 to 9 inches. Below this depth large travertine masses form the main deposit. The sample of travertine soil analysed was collected from the middle of Southern Island. The analysis (Sample 1) shows that there is 6 per cent. humus, 9·7 per cent. calcium carbonate, ·38 per cent. nitrogen, ·79 per cent. sodium chloride. It was distinctly alkaline pH=8.

The granitic soils range from talus and rubble to coarse sands. The water-retaining capacity of such soils is low, and the rain that falls upon them would rapidly percolate to the solid rock below. These soils are invariably dry and powdery to the touch. The samples felt "air dry" at the time they were collected. Five samples were taken, one in each of the two main communities—*Atriplex*, "saltbush," plain (Sample 2), *Casuarina* woodland (Sample 3)—and three in Main Creek, at the head and in the upper part, to test the range of salinity in the soil (Samples 4, 5, and 6).

Samples 2 and 3 show a general similarity. The *Casuarina* woodland has, as might be expected, the higher humus content, 13·9 per cent., as against 9·9 per cent. in the saltbush soil. Both soils have only average salinity (·20 per cent., ·23 per cent.). The most striking difference is in the pH values. The woodland soil has an acid reaction pH=6; the saltbush plain is somewhat alkaline, pH=7·4.

Sample 4 is typical of much of the poorer soil on well-drained slopes. Such soils are poor in humus and soluble salts. Samples 5 and 6 were taken respectively at the edge of and within one of the granite basins that occur at

the head of Main Creek. Sample 6 is clearly affected considerably by the evaporation of sea water. It has a high salt content, sodium chloride 3·08 per cent., but is poor in humus, 3·8 per cent., and also in nitrogen, ·07 per cent.

All these granitic soils, except that from the *Casuarina* woodland, are neutral or on the alkaline side of neutrality.

III. Biotic.

Biotic factors in the environment do not have so obvious an effect upon the flora of the Pearsons as they have upon the Franklins.[5] The soil is unsuitable for the burrowing activities of either the mutton birds or penguins, which were so abundant there. Mutton birds are absent and the penguins have to nest under rocks. The only grazing animals are the indigenous wallabies *(Petrogale pearsoni),* which are frequently seen on Northern Island. Their chief food plant appears to be *Atriplex paludosum,* but their feeding does not damage the bushes appreciably. One strange feature is the remarkable abundance of the droppings of some insect. These occur thickly on the surface of many soils, especially in the *Olearia* shrubland and the lower slopes of the *Casuarina* woodland. The faeces are hard, black pellets, roughly cylindrical, 2 to 3 mm. long by 1 mm, in diameter. They are extraordinarily frequent in some places and can be swept up off the soil by the handful. Mr. A. M. Lea, Entomologist of the S.A. Museum, kindly informs me that they resemble the dung of a cockroach. A large species of this insect is generally found under stones on the island. Judging by the amount of dung, they must occur in very large numbers at some seasons. Presumably they feed on vegetable *debris,* which they return to the soil in a form that is not readily removed by wind or leeching. The deposit is so abundant as to affect considerably the percentage of nitrogen in the soil anlayses.

Human interference with the vegetation is limited to the results of one or two fires that have been started on the islands by visiting vandals. The effect of these has been almost to destroy the Casuarinas south of Main Creek; elsewhere the burnt-out flora has regenerated well. Several years ago a number of sheep were landed upon the Northern Pearson. There are none there now, and the vegetation appears uninfluenced by them, unless the grass *Festuca bromoides* was brought to the island by this means. *Festuca bromoides* was the only non-indigenous Australian plant collected, except the variety *littoralis* of *Sonchus asper.*

VEGETATION.

Three main vegetation types occur on the Pearsons, exclusive of various communities on cliff faces, creek beds, blown sand, etc., which are not easily placed in relation to the others. They are:—(1) The woodland and scrub series on granitic soil with a climax of *Casuarina stricta* woodland; (2) saltbush consisting of *Atriplex paludosum* dwarf shrubland, occurring chiefly on granitic soil; and (3) the various communities on travertine limestone. The first two types may be considered as formations, and the ecotone lines are usually clearly distinguishable. An exception occurs on the right, or south, bank of Main Creek. There the blurring of the line appears to have been affected to some degree by fire. The last series, as explained below, is formed merely as a matter of convenience.

Woodland and Scrub Series.

I. *Casuarina stricta* woodland.

A woodland, or "forest," of *Casuarina stricta* occurs on the three large hills of Northern Pearson. The trees grow to a height of 20 to 30 feet (pl. v., fig. 1). The length of the green assimilating branches varies considerably with

[5] Osborn, T. G. B., *loc. cit.*, p. 203, 1922.

the degree of exposure. In exposed places they may be no longer than 6 to 8 inches and stand erect, while in sheltered parts they are 18 to 24 inches long and bend with a graceful curve, giving the familiar rounded silhouette to the trees.

Casuarina stricta woodland is only a closed community in the most sheltered parts of 781 Hill. In other parts there is an underwood of various trees or shrubs, *e.g., Melaleuca parviflora, Leucopogon Richei,* which mingle and compete with the sheoak. The soil is coarse with a humus content of 13·9 per cent., but has only a low water-retaining capacity. In places between the granite boulders there is a considerable depth of soil. Frequently the "forest" ends abruptly (pl. v., fig. 1), owing to the presence of some large exposure of granite. Several such places occur on 781 Hill, and one passes at a step from the climax to the earliest phases in the succession. In the woodland the ground below the trees is covered by a litter of fallen branchlets, old fruits, or tree trunks. The forest suffered several years ago by fire, but it is generally regenerating well; many seedlings and young trees of various ages occur.

Mosses are common, but in January were quite dried up. Mr. L. Rodway, C.M.G., of Hobart, kindly determined the following: *Bryum intermedium, Tortula muralis* (form with a cuspidate hair point), and (?) *Acanthocladium,* sp.

Herbaceous plants of the most sheltered places are:—

Cheilanthes tenuifolia	*Agropyrum scabrum*
Festuca bromoides	*Didiscus pusillus*

During the winter and spring no doubt others would be found, but at the time of our visit they were not to be seen. These herbaceous plants disappear on hotter or more exposed places, *e.g.,* the west face of the summit of 781 Hill and xerophytic perennials as *Mesembryanthemum aequilaterale* replace them. Several colonies of *Senecio Cunninghamii* were found in sheltered places on 781 Hill. This is a half-shrubby plant with lanceolate leaves 8-12 cm. by ·8-1·2 cm. that are glossy above and glaucous on the lower-surface. It has a less xerophytic appearance than any other perennial on the island.

The undershrub flora varies with differing degrees of dryness and exposure. Just below the summit of 781 Hill, on the north-east side, there is an open area with bushes of *Calythrix tetragona,* found nowhere else on the island. The most usual undershrub in the more sheltered places is *Leucopogon Richei,* which, though it appears in the open shrub association described below, is not found in the most exposed places of the *Casuarina* woodland. Other plants occasionally associated with *Leucopogon Richei* are *Dodonaea viscosa* and *Cassinia spectabilis.*

In more exposed places, *e.g.,* the summit of 781 Hill, on East Hill, especially at the col and on the lower slopes, *Melaleuca parviflora* appears as the undershrub and even replaces *Casuarina* (pl. v., fig. 2). It develops a distinct and more xerophytic community. Transitions were seen in many places, but most clearly on slopes with a northern aspect (pl. iv., fig. 1). The fire, or fires, referred to earlier appear almost to have destroyed the Casuarinas of the north facing slope above the right branch of Main Creek. *Melaleuca parviflora* forms a dense thicket in which only a few Casuarinas are present. On Southern Island there is a small group of about half a dozen stunted Casuarinas growing on the most sheltered part of the north side. This represents a small outlier of the *Casuarina* woodland which has every likelihood of dying out, since none of the trees were fruiting nor were any old fruits to be seen below them.

II. *Melaleuca parviflora* scrub.

A mixed scrub community in which *Melaleuca parviflora* often attains the size of a small tree occupies the foot of 781 Hill and other hills on Northern Island (pl. iv., fig. 2). The plant is absent on Middle and Southern Islands.

It rarely exceeds 15 feet in height and frequently has several slender stems terminating in a dense canopy of foliage-bearing shoots. The association is generally an open one, other shrubs being:—

Rhagodia baccata
Correa speciosa
Spyridium eriocephalum
Pimelia serpyllifolia
Westringia rigida, var. *dolichophylla*
Myoporum deserti
Olearia ramulosa

The soil is a coarse granitic sand of much the same type as in the *Casuarina* woodland, but lacking the dark colour due to humus. It was bare of annuals in January, nor could any sign of their dead remains be seen. A small number of perennial species occurs in open places; these are plants characteristic of earlier phases of the succession, *e.g.*:—

Poa caespitosa, var. *Billardieri*
Mesembryanthemum aequilaterale
Scleranthus pungens
Pelargonium australe

Atriplex paludosum occurs in several open areas on the north side of Main Creek as small inliers of saltbush plain (pl. viii., fig. 2).

III. *Olearia-Leucopogon* thicket.

A mixed community of shrubs, of which *Olearia ramulosa* and *Leucopogon Richei* are the most important, exists on some of the lower slopes of the hills of Northern Island, covers South Hill so far as exposure will allow, and occurs also on Middle Island. More than one association is probably involved here, but there is so much intergradation between the differing habitats owing to exposure, the broken nature of the ground, etc., that it is inadvisable to attempt to define different communities.

The conditions of development of this *Olearia-Leucopogon* associes are generally similar to those producing *Casuarina* woodland or *Melaleuca* scrub at higher levels or where exposure is less severe. The soil is granitic sand held in clefts of various depths, or terraces between the boulders or tors. Exposure to heat and wind is greater than in the case of the two former communities, while the soil is less stable owing to the more rapid weathering of the rocks. The effect of aspect and exposure on the development of this thicket has been referred to in the case of East Hill (pl. iv., fig. 1).

Other plants noted as occurring in this community are:—

Rhagodia baccata
Enchylaena tomentosa
Lepidium foliosum
Correa speciosa
Mesembryanthemum aequilaterale
Myoporium insulare

On Middle Island and portions of Northern Island, near the head of Main Creek and the south-west corner of the island generally, it is not possible to define the communities even within the broad limits mentioned above. The conditions in these localities are less stable owing to weathering of the rock, extremes of exposure to the south-west gales alternating with comparative protection in hollows of the rock, the possible influence of spray, and so on. In addition to the plants mentioned others are present that are the earliest colonists of rubble soil. Such are:—

Poa caespitosa, var. *Billardieri*
Scleranthus pungens
Pelargonium australe

Occasionally are found bushes or local patches of *Atriplex paludosum* which typically occurs as the dominant in a distinct community.

IV. *Pelargonium-Mesembryanthemum-Poa* community.

This is the earliest phase noticeable in the colonization of granite rubble in shallow pockets in the rock on all the islands. The community is composed of *Pelargonium australe, Mesembryanthemum aequilaterale,* and *Poa caespitosa,* v. *Billardieri.*

The pelargonium is low growing with succulent half-shrubby stems. The plant has a stouter habit of growth than it has when growing on sand dunes on the mainland. *Mesembryanthemum aequilaterale* is another dune plant which on Pearson Island has a less spreading mat habit than is usual. *Poa caespitosa,* v. *Billardieri,* has wiry, pungent-pointed leaves, and the short straw-coloured panicles typical of the variety. These plants appear in exposed, barren soil at all levels. Thus, at the summit of 781 Hill the *Mesembryanthemum* and *Poa* are growing along the exposed precipitous western face. They also occur on the bare patches of coarse sand in the upper part of Main Creek. There the soil (Sample 4) is poor and deficient in soluble salts. Transitions between this community and the *Olearia-Leucopogon* thicket are common. The shrub appearing first is *Olearia ramulosa; Rhagodia baccata* less commonly. The annual *Lepidium foliosum,* too, is often found, as is the cushion plant *Scleranthus pungens.*

Communities on the Granite Cliffs.

Exposed, precipitous, granite cliffs occur on most parts of the islands. The type of vegetation they bear is largely a depauperate form of the neighbouring less exposed faces, but it seems permissible to refer to cliff floras. Naturally, an important factor influencing these is the degree of exposure to salt spray.

In the most exposed places the cliffs, or platforms, of rock that rise at an angle of 30° to 45° from the sea are entirely bare for 100 to 150 feet above tide marks. In rubble pockets above this height occur such plants as *Mesembryanthemum australe, Salicornia australis,* and *Sueda australis.* These all grow stunted in small mats. The habitat is not suitable for most flowering plants, and even lichens and algae are absent. The relatively rapid weathering of the rock faces may account for this, as well as exposure to heat, wind, and spray. The surface of the granite in these places is either smooth where exposure is most severe, or crumbly and flaky to the touch owing to rapid weathering. Below such places is a conspicuous layer of coarse barren *debris.*

Other cliff plants are really chasmophytes growing in deep cracks between the boulders. In such places occur, in addition to the above, *Calocephalus Brownii, Ixiolaena supina* (both confined to sea cliffs), *Frankenia pauciflora, Threlkeldia diffusa, Enchylaena tomentosa, Tetragona implexicoma, Scleranthus pungens,* and, where less exposed to spray influence, *Mesembryanthemum aequilaterale, Olearia ramulosa,* and *Rhagodia baccata.* All these must receive some direct spray in stormy weather, though, owing to the open soil and good run off, the local accumulation of salt will be slight.

On top of the sheer cliffs 200 feet high, near to the source of Main Creek, are a number of shallow depressions in the granite filled with rubble and clay (soil Sample 6). The soil analysis shows that sodium chloride is present, also a certain amount of clay, otherwise conspicuously absent in the soils. These rock basins supported little vegetation (pl. iv., fig. 2). Stunted bushes of *Arthrocnemum halocnemoides,* var. *pergranulatum,* occur, together with *Salicornia australis, Frankenia pauciflora,* and *Mesembryanthemum aequilaterale.* Around some of the basins are the prostrate trees of *Melaleuca halmaturorum* referred to earlier.

True lithophytes are certain Myxophyceae that occur by the runnels made by fresh water drainage over the bare rock slopes. These were quite dry in January, but are most noticeable as dark olive-green to black bands across the

stone. The flow of water down these channels would be very intermittent even in the wet season, owing to the small catchment and non-retentive nature of the soil covering parts of it. Scrapings of the dried algal growth showed only *Tolypothrix* sp.

Watercourses.

The two species of *Melaleuca* are the most prominent plants of watercourses on Pearson Islands. *Melaleuca parviflora* occurs along the beds of the two fresh water creeks, North Creek (pl. ix., fig. 2) and the tributary to Main Creek. It is not, of course, confined to this habitat, but when growing beside a watercourse descends further from the hills on to the plain below.

Melaleuca halmaturorum is restricted to the course of Main Creek, which it follows from source to near the mouth (pl. vi., fig. 2, and pl. vii., fig 1). This is a paper bark tea-tree, well known from habitats elsewhere in South Australia to have a high salt toleration. The water flowing down Main Creek is derived from two sources. Drainage from 781 Hill and the tors at the south-western corner of the Northern Island provides the bulk of it, but sea spray contributes some water as overflow from the granite basins described above. The upper course of the creek is indefinite and appears to be shifting. No special creek flora can be described in connection with it. The plants growing in the wide indefinite channels have been referred to under the *Pelargonium-Mesembryanthemum-Poa* community.

Drainage channels are common near to the bare granite slopes in other parts of the islands. *Ulothrix* sp. covers the soil, and growing amongst it occur such ephemerals as:—

Centrolepis sp. *Cotula coronopifolia*
Calamgrostis filifolia

Such channels do not influence to any appreciable extent the flora of perennial plants around them.

Saltbush Formation.

Atriplex paludosum dwarf shrubland.

A typical saltbush formation is developed on several parts of Northern and Southern Islands. The principal habitat is upon the gently sloping plains that occur at the foot of the steep rocky slopes. The soil of these areas is composed of fine granitic rubble, almost sandy in texture. The free open soil is one that, in spite of its humus content, has only a low water-retaining capacity. In January many of the shrubs were obviously showing the need of water, the leaves were often flaccid, and the older ones falling off.

The temperature and insolation factors on these exposed plains must be severe. It is probable that the light grey-green colour of the *Atriplex* leaves may be correlated with light protection.

The *Atriplex* bushes stand 12 to 18 inches high, and in places form an almost closed community (pl. vi., figs. 1 and 2). Only one other plant, a small annual composite, was found on the typical saltbush plain.

Atriplex paludosum appears to be a plant that will not tolerate much moisture in the soil. Its specific name is not at all appropriate to its South Australian habitats. Depressions on the plains were colonized by *Rhagodia crassifolia* (pl. vii., fig. 1). The same plant replaces *Atriplex* at the base of the steep rocky rises above the plains, where the influence of drainage from the slopes above will be most pronounced (pl. vi., fig. 1).

It will be noticed from the analyses of soil Sample 2 (NaCl=·20 per cent.), that *Atriplex paludosum* growing on Pearson Island is not a halophyte. It was absent from the flora of the basins at the head of Main Creek, where the soil was very salt (Sample 6), though it occurred at their edges, where the salinity was even lower than in the *Atriplex* plain (Sample 5, NaCl=·15 per

cent.). The *Atriplex paludosum* association observed is a xerophytic community, not a halophytic one.

Though saltbush dwarf shrubland grows best on granitic soils, it is not confined to them. It is developed upon the higher levels of the travertine plateau on Northern Island, and at the eastern end extends almost to the coast. Exposure to sea spray is less here than on the other travertine areas. On such soils the community tends to be a mixed one, *Lycium australe, Lepidium foliosum,* and *Senecio lautus* being present. The *Atriplex* bushes are more stunted than in the pure community, with bare soil between them.

On the west side of Main Creek, *i.e.*, the dry north facing slope, patches of *Atriplex* occur as inliers in the open shrub community of *Melaleuca parviflora* described above (pl. vii., fig. 2).

Travertine Limestone Communities.

It has been remarked before that the principal limestone areas can be recognized at once by the different type of vegetation that they bear. These communities are grouped together as members of a separate series. No climax is distinguished, and it is possible that were a larger series available the communities would find their place as seral units in a formation culminating either as *Atriplex* dwarf shrubland or *Melaleuca parviflora* scrub according as climatic factors were more or less xerophytic.

In regard to the travertine limestone habitat on Pearson Island, one observes that in addition to the obvious feature of calcium carbonate in the soil there must also be considered the shallow depth of soil overlying the limestone deposit, exposure to light and wind owing to the unbroken nature of the terrain, and, in some cases, *e.g.*, the soil sample analysed, No. 1, an appreciable amount of sodium chloride. In spite of these features, it is not possible to recognize such a definite limestone community as that of *Frankenia fruticulosa* seen on Franklin Island.[6] Though the travertine areas may be recognizable at once owing to the difference in the plant covering, it is less easy to define wherein that difference lies. It is usually one of degree and varying proportions of plants occurring elsewhere on the islands, rather than one due to the presence of plants limited in their distribution to these areas. Three communities are sufficiently distinct to be briefly noted:—

I. *Mat Plant Community.*

A community consisting of prostrate or semi-prostrate dwarf perennials occurs on most of the plateaux (pl. viii., fig. 2). The majority of the plants are more or less succulent, and many of them have their leaves coloured owing to the presence of anthocyanin pigments. The general effect thus produced is most striking, resembling some gigantic carpet worked in grey *(Atriplex),* orange or red *(Mesembryanthemum),* maroon *(Threlkeldia),* grey-green *(Enchylaena),* or olive-green *(Frankenia).* The species noted are:—

Chenopodium sp. (affin. *microphyllum*)
Enchylaena tomentosa
Threlkeldia diffusa
Atriplex cinereum
Mesembryanthemum australe
Frankenia pauciflora

II. *Cliff Faces.*

The seaward edges of the plateaux end in low cliffs 4 to 8 feet high; at the margin of the cliff faces grow:—

Arthrocnemum halocnemoides, var. *pergranulatum*
Salicornia australe
Enchylaena tomentosa
Suaeda australe
Tetragonia implexicoma
Nitraria Schoeberi
Frankenia pauciflora

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[6] Osborn, T. G. B., *loc. cit.*, p. 201, 1922.

The Salicornias and *Suaeda* occupy the places most exposed to spray. Elsewhere *Nitraria* is the most important plant, often forming almost a thicket, over the bushes of which *Tetragonia* and *Enchylaena* scramble.

III. *Annual Community.*

The plant covering growing upon the plateau of Middle Pearson Island is of a type not seen elsewhere in the group (pl. ix.; fig. 1). The main plants observed were:—

Lepidium foliosum — *Senecio lautus*
Apium prostratum

Of these only the *Lepidium* was living in January. Occasional clumps of *Enchylaena,* the only perennial noted, occurred over the area.

This plateau rises steeply at the western side to the granite summit, the junction being a fan of talus from the tors above (pl. ix., fig. 1). At the junction of fan and plateau there is a belt of *Atriplex cinereum* noted above as a constituent of the travertine flora. The vegetation of the fan belongs, of course, to the mixed shrub community on granite rubble, *Olearia ramulosa* predominating.

It is very noticeable that the *Olearia* does not colonize the travertine, though it is found growing in clefts in granite exposures on either side of the plateaux.

Communities influenced by Blown Sand.

Littoral.

The only littoral plant on Pearson Island is *Atriplex cinereum*, which grows in a small patch at the north-west corner of the landing place (pl. viii., fig. 1). The habitat is one in which *Atriplex cinereum* [7] commonly occurs on the mainland, but the habit is unusual. The plant grows creeping or semi-prostrate, and so accumulates blown sand about itself through which it grows, forming mounds 2 to 3 feet high and 4 to 6 feet in diameter.

The other portions of the coast are unsuitable to the growth of flowering plants, being either boulders or platforms of bare granite often of great extent.

Blown Sand on Granite Rubble.

Behind the area mentioned above there is a trough in the granite extending inland in which wind-borne sand mingles with the rubble. *Atriplex cinereum* is replaced by *Frankenia pauciflora,* which also holds the sands, forming low mounds a foot or more in diameter; a similar growth form of this plant was observed on Franklin Island. Other plants are those of open communities influenced by sea spray, except *Lavatera plebeja,* which was seen nowhere else on the islands.

DISCUSSION.

Plant Succession.

On so small an area climatic differences are not very marked, though it is probably quite justifiable to regard the rubble plains and slopes at the foot of the hills as more arid than the hills themselves. In atmospheric humidity, intensity of insolation and temperature, if not in actual rainfall, the plains have a more xerophytic climate than the hills. It is convenient to group the succession seen on Pearson Islands into three series. The plains bear a "saltbush" flora, that of the hills falls into a *Casuarina* woodland and a shrub series culminating in *Melaleuca parviflora* scrub, and the flora on travertine limestone is the third.

[7] Osborn, T. G. B., Brit. Assocn. Report, Austr., 1914, p. 505.

There is need of further investigation of the saltbush flora in Australia, but pending the publication of further work on the subject, it may be said that saltbush is considered as essentially an arid and not a halophytic formation. A saltbush plain of the type described above is a seral unit in the formation as displayed on the mainland, but the *Atriplex paludosum* consocies on Pearson Islands is, in that locality, a subclimax. It is related to *Rhagodia crassifolia* consocies, which is the most stable community on Franklin Island. This is shown by the interesting occurrence of local patches of *Rhagodia crassifolia* in the saltbush on Pearson Islands. *Rhagodia crassifolia* open shrubland was considered a subclimax on Franklin Island, but I now regard the succession suggested, *i.e.*, towards a scrub woodland involving *Melaleuca parviflora*, as mistaken. The examination of Pearson Island shows that *Melaleuca parviflora* properly has its place in a different and less xerophytic line of succession.

The woodland series on the hill slopes shows a greater number of successional stages than the saltbush; this is to be expected in a less arid sequence. It is a formation of less xerophytic type, as is shown by the occurrence of mosses, *Cheilanthes tenuifolia* and *Calythrix tetragona*. The two last grow on the Mount Lofty Ranges in a rainfall of over 30 inches. *Casuarina stricta* consocies is a closed community at the higher levels. This species on the mainland does not form a climax associaton, but is an early stage in the sclerophyllous woodland series. *Casuarina stricta* in South Australia is characteristic of rocky outcrops, where it obtains deep but well-drained soil. On Pearson Island the forest succession goes no further than the *Casuarina* woodland, the edaphic factors as well as such a climatic factor as wind militating against the growth of most trees.

The *Melaleuca parviflora* consocies is a scrub woodland of a more xerophytic type than the *Casuarina* woodland. *Melaleuca parviflora* forms dense thickets of considerable extent on some of the neighbouring islands, *e.g.*, Flinders Island, and also on the mainland. On the mainland, however, it is certainly a stage in the sere culminating in mallee (*Eucalyptus* spp.).

The accompanying figure shows graphically the relationship between the communities on the granite slopes:—

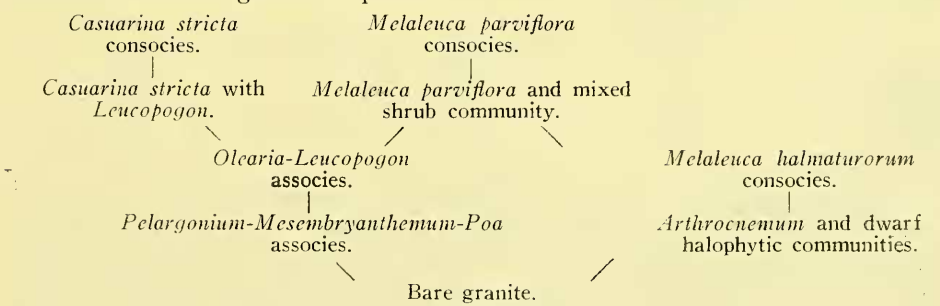

Fig. 2.

Diagram to show the relation of the chief scrub and woodland communities on granite.

The separation of the communities on travertine limestone into another group is a matter of convenience rather than an expression of difference. A saltbush flora develops upon travertine areas upon the mainland, for travertine limestone, of course, is not so much a geological formation as an indication of a climate with a high evaporation rate. On Pearson Island we find an open community with *Atriplex paludosum* as the dominant species upon parts of the plateaux. It is possible that some, at least, of the travertine communities should find their place in the saltbush formation, but at present it is preferable to group all the limestone communities together.

Though the main communities on Pearson Island are at present in an active state, the ultimate fate of the islands will be a bare granite reef if the present cycle of denudation continues. Middle and Southern Pearsons show no community higher than *Olearia-Leucopogon* thicket. The outlying islands appeared to have few, if any, bushes upon them. The rate of degeneration upon Northern Pearson, however, will remain slow, provided the flora is protected from malicious fires.

Flora.

A complete list of the vascular plants collected is given in Appendix II. It comprises 52 species, though, as the islands were visited in the dry season, the list is probably incomplete as far as herbaceous plants are concerned. The most important families are: Chenopodiaceae (10 species), Compositae (9 species), and Gramineae (5 species).

No member of the Leguminoseae was found on the islands. None were found in the flora of Franklin Island.[8] Considering that the Leguminoseae is the family represented by the greatest number of species in the Australian Flora,[9] its apparent absence is remarkable.

The Myrtaceae are represented by three species, but no Eucalypt is present. This, again, is a surprising feature, for mallee Eucalypts occur on the coast of the neighbouring mainland.

The Centrolepis appears to be new, but it was obtained with fruits only. An attempt is being made to raise it from seed, and, if successful, the plant will be described later by Mr. J. M. Black.

In the list given below the growth forms according to Raunkaier's system are also stated. There are three species of low trees (Microphanaerophytes, 5·7 per cent.) and 19 species of shrubs (Nanophanaerophytes 36 per cent.), making altogether a phanaerophyte flora of 41·7 per cent. This is very nearly the phanaerophyte percentage for the normal spectrum (43 per cent.), but there are no other trees than microphanaerophytes and there is an overwhelming preponderance of shrubs.

District.	Total number of Species considered.	Percentage of Species belonging to each Life Form.									
		MM.	M.	N.	Ch.	H.	G.	HH.	Th.	E.	S.
Pearson Island ..	53	—	5·7	36	28·3	1·9	—	—	28·2	—	—
Franklin Island ..	34*	—	—	15	38	—	—	—	47	—	—
Ooldea	188	·5	19	23	14	4	·5	—	35	4†	—
Natal	3,034	3	14	14	19	18	18	5·5	6·5	1	1
Normal Spectrum	400	6	17	20	9	27	3	1	13	3	1

The number of dwarf shrubs or herbaceous perennials is 15. These have no special protection for their buds, but are mat plants, cushion plants, or grow in tussocks (Chamaephytes 28·2 per cent.). The percentage is more than three times that of the normal spectrum. On the Franklin Islands the percentage was even higher. This may partly be attributed to the rather special habitat in wind-swept islands, but there may be other reasons. When examining the arid type of flora at Ooldea, Adamson and the writer[10] found a rather high percentage

*The total number of species is so small that the percentages may be misleading unless taken in a general way as emphasising the abundance of chamaephytes and therophytes and the absence of most of the other life forms.

† The epiphytes here were hemiparasites, very prominent in arid districts of South Australia, for which no provision is made by Raunkaier's system.

[8] Osborn, T. G. B., *loc. cit.*, p. 204, 1922.

[9] Maiden, J. H., Australian Vegetation, Federal Handbook on Australia, p. 166, 1914.

[10] Adamson, R. S., and Osborn, T. G. B., On the Ecology of the Ooldea District, Trans. Roy. Soc. S. Austr., xlvi., p. 558, 1922.

of Chamaephytes (14·1), and Bews [11] in the Flora of Natal notes the same thing (19 per cent.). Raunkaier has shown that Chamaephytes increase towards the polar regions and also in hot climates with a dry season. Even allowing for the fact that the Pearson Islands have a restricted flora and a special type of habitat, the relatively large number of Chamaephytes is a feature of the flora that agrees with the few other biological spectra that have been published for Southern Hemisphere floras. The Chamaephyte protects its buds by the shelter of the plant itself or its dead remains heaped around them. These persistent aerial portions also serve as a break that arrests movement of unstable soil. In the case of Hemicryptophytes protection is gained as a result of the subterranean position of the renewal buds which lie in the upper crust of the soil. This method is less suitable for unstable soil, which may "drift," exposing the buds. Also, in dry weather the dead remains are likely to be blown away instead of remaining heaped over the buried portions. It must be remembered that in South Australia the adverse period is a time of drought and heat, not cold.

Hemicryptophytes (H) are represented on the Pearson Islands by a single species, the fern *Cheilanthes tenuifolia* (H, 1·9 per cent.). None were found on Franklin Island and only 4 per cent. at Ooldea. This rarity of Hemicryptophytes in the floras of the three arid districts of Australia, which have up to the present been investigated on Raunkaier's system, is a feature requiring further examination.

No geophytes were observed. This may be due to the season of the year, but it may be recalled that only a single species was observed at Ooldea in the winter months.

The therophyte flora (Th, 28·2 per cent.) is less than that at Ooldea or Franklin Islands, but the percentage is still double that of the normal spectrum. It is probable that the number of annual species would be increased were it possible to visit the islands during the wet season, though comparisons with Franklin Islands are quite justifiable since those islands were also visited in January. Probably the percentage of therophytes on Pearson Islands is less than that of the other two districts because, owing to the topography of the islands, denudation is more rapid and the soil correspondingly less stable.

Appendix I.

ANALYSES OF SOIL SAMPLES FROM PEARSON ISLANDS.

By J. G. Wood, B.Sc.

The samples were all obtained from a section through the first 4 to 6 inches of the soil after brushing away the surface layer. They were, all but No. 1, derived from granite, and are of the "coarse sand" type, *i.e.*, the majority of the particles have a diameter of from 1 to 0·2 mm., and consequently the soils have little water-holding capacity. This is modified in the case of soil No. 6, which has a considerable amount of clay, and also in Nos. 2 and 3, which have 9·9 per cent. and 13·9 per cent. of humus, respectively.

Before analysis the soils were air-dried and then passed through a 10-mesh (2·6 mm.) sieve, and the sieved soil was finely ground and used for analysis. The screenings consisted of fragments of granite, felspar, quartz, and in some cases (mentioned below) dried vegetation as twigs, roots, etc., and also droppings from cockroaches. The screenings in each case amounted to about one-third of the total sample of soil.

The results of the analyses are set forth in the table:—

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[11] Bews, J. W., The growth forms of Natal Plants, Trans. Roy. Soc. S. Africa, v., p. 624, 1916.

No.	ZONE	Description	Water at 100°c.%	Combined Water	Humus	Total Chlorine	Sodium Chloride	Total Salts	Carbon Dioxide	Calcium Carbonate	Nitrogen	pH.
1	*Mesembryanthemum australe*, with *Atriplex cinereum*, from Travertine plateau, Southern Pearson	Coarse granite sand with twigs and dung	2·1	—	9·0 after allowing for twigs 6·0	·48	·79	—	4·3	9·7	·38	8·0
2	*Atriplex paludosum*, Southern Pearson	Coarse granite sand with twigs and dung	2·2	—	12·9 after allowing for twigs 9·9	·12	·20	—	Nil	Nil	·40	7·4
3	*Casuarina* woodland, well up slope but below *Cheilanthes* zone *(Casuarina* and *Leucopogon)*	Coarse sand with dark humus and dung	1·8	—	13·9	·14	·23	—	Nil	Nil	·50	6·0
4	Head of creek with *Scleranthus*, *Poa*, and *Mesem. aequilaterale*	Granite sand, no twigs nor dung	·6	—	3·1	·04	·06	—	Nil	Nil	·09	7·2
5	*Atriplex paludosum* at rim of basin	Granite sand with no twigs, more humus and less dung	1·1	—	6·5	·09	·15	—	Nil	Nil	·24	7·0
6	Basin at head of creek, with *Arthrocnemum* and wind-blown *Melaleuca*	Granite sand with clay, no twigs nor dung	4·5	3·0	3·8	1 87	3·08	3·4	Nil	Nil	·07	7·4

Little need be said regarding the moisture at 100° C. This is low, as would be expected of coarse sands, and the range is small between the different samples. The water-retaining-capacity factor alone appears to influence the plant distribution very slightly. The highest percentage of water is reached in the case of soil No. 6, obtained from the basin at the head of the creek. It contains more clay than the other soils, the felspar being largely kaolinized.

The presence of clay (hydrous silicate of alumina) is reflected also in the second column (combined water). Rough estimations showed that the combined water was practically nil in all cases except in soil No. 6, where it was determined. It amounted to 3 per cent.

The column headed "humus" was determined by the loss on ignition after deducting the CO_2 and the total water content, which gives approximately the percentage of humus. This is complicated in the case of soils Nos. 1 and 2 by the fact that a good deal of dried undecomposed plant *debris* (twigs and portions of roots) passed through the sieve. To determine these the soils were shaken with water, when most of the small twigs floated to the top. These were collected and dried, and were found to amount to about 3 per cent. in each case. They do not, however, alter the relative positions of the soils in regard to humus content. Soil No. 3 is a dark soil from the *Casuarina* woodland zone containing 13·9 per cent. of humus and comparatively free from small twigs.. As one usually finds in woodland soils, it contains an acid humus, as is shown in the pH value in the last column in the table. This soil forms a notable contrast with soil No. 2, with which it is practically identical in composition, except that the humus content is about 4 per cent. lower in No. 2 (taking the twigs into account).

No. 2 soil is not acid, however, but on the alkaline side of neutrality (neutrality pH=7·0). It appears possible that the reaction of the soil may be one of the factors influencing the type of flora, for whilst the acid soil supports *Casuarina* and *Leucopogon*, the alkaline one is covered with *Atriplex*. In soil No. 5 the organic matter is well decomposed and contains no twigs. It approximates soil No. 2 in composition, though it is poorer in humus. Soil No. 4 is very deficient in organic matter. It is a typical barren granitic soil.

The fourth column gives the percentage of chlorine, and the next these percentages calculated as sodium chloride. There is practically no K Cl present, the potassium which is present being combined with aluminium silicate in the clay. A determination of the total soluble salts in soil No. 6 showed that these amounted to 3·4 per cent., and of this 3·08 per cent. was Na Cl, as calculated from the chlorine content. There was very little potassium present. The salt is derived from sea spray, and the analyses show that two soils, Nos. 1 and 6, have abnormally high percentages.

The most interesting feature brought out in connection with the salt content is the range of *Atriplex*, which is usually classed as a halophyte. In Nos. 2 and 5, with an average soil saline content, *A. paludosum* thrives, while *A. cinereum* tolerates 0·97 Na Cl. In soil No. 6, where the salt content is high (due to accumulation by evaporation of sea water in the basin), *Atriplex* is absent. The characteristic vegetation is *Arthrocnemum halocnemoides*, var. *pergranulatum*, and *Melaleuca halmaturorum*.

The presence of *Atriplex* spp. in the areas of low salt concentration, and their absence from soils with a high percentage of sodium chloride, supports the objection that has been made to classing the "saltbushes" of Australia as halophytes.[12]

The carbonate content calls for no comment here; calcium carbonate is present only in the soil from the travertine plateau.

[12] Adamson and Osborn, Trans. Roy. Soc. S. Austr., xlvi. (1922), p. 544.

As regards nitrogen, soils Nos. 4 and 6 only show the amount which one would expect from soils of this type *(i.e.*, around 0·1 per cent). The other soils are high. This is accounted for by the large amounts of droppings from the cockroaches before mentioned. The screenings of Nos. 1, 2, and 3 particularly had large amounts of dung, while it was less evident in Soil No. 5. This "manuring" must appreciably affect the luxuriance of growth. Unfortunately, no two soils taken resemble one another in all save nitrogen content, so one cannot make a quantitative camparison.

In the last column are given the pH values of the soils. These were determined colorimetrically, using Clark and Lub's series of indicators.[13] They bear out one's expectations. The forest soil, with high humus content and exposed to wind,[14] is acidic, while the limestone soil is alkaline. The other granite soils are also slightly on the alkaline side. This latter feature was not unexpected, although granite soils, as a class, when not near the sea are slightly acidic. On the island, however, the soils can all be reached by sea spray (either by dashing on rocks or carried by wind), and sea water itself has a pH of about 8·2, due mainly to magnesium and calcium salts. It is probably this fact which brings the reaction from slight acidity to slight alkalinity. The possible correlation between the vegetation and these values has been mentioned under "humus."

Appendix II.

LIST OF SPECIES COLLECTED.

Following is a list of the species collected on Pearson Island. I am grateful to Mr. J. M. Black for kindly examining my collection and determining some of the plants. The Centrolepis will be described by him later.

In addition to the name of the plant and its growth form according to Raunkaier's system, notes on the habit are given and the community in which it occurs. The habit notes, leaf measurements, etc., refer to Pearson Island specimens:—

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[13] Clark, Determination of Hydrogen Ions, 1920.

[14] Warming, Oecology of Plants, p. 62.

Name.	Raunkaier's Class.	Habit.	Community.
POLYPODIACEAE.			
Cheilanthes tenuifolia, Schw.	H.	Small tufted fern	*Casuarina stricta* consocies
GRAMINEAE.			
Calamagrostis filifolia, (Forst.) Pilger	Th.	Small tufted grass	„ „
Danthonia penicillata, (Labill.) F. v. M.	Th.	„ „	„ „
Poa caespitosa, var. *Billardierii*, Hook. f.	Ch.	Pungent leaved tussock grass, leaves up to 30 cms.	*Pelargonium-Mesembryanthemum-Poa* associes
Festuca bromoides, L.	Th.	Small annual grass	*Casuarina stricta* consocies
Agropyrum scabrum, (Labill.) Beauv.	Th.	„ „	„ „
LILIACEAE.			
Dianella revoluta, R. Br.	Ch.	Tussock plant with revolute leaves 40-50 cms. long	*Pelargonium-Mesembryanthemum-Poa* associes
Bulbine semi-barbata, (R. Br.) Haw.	Th.	Dwarf herb	*Olearia-Leucopogon* associes
CENTROLEPIDIACEAE.			
Centrolepis sp.	Th.	Minute tufted herb	Fresh water swampy drainage channels
CASUARINACEAE.			
Casuarina stricta, Ait.	M.	Tree up to 6-9 m.	Dominant on hill summits
CHENOPODIACEAE.			
Rhagodia baccata, Moq.	N.	Shrub, up to 2 m., often scrambling habit	Cliffs, *Olearia-Leucopogon* associes, river bed
R. crassifolia, R. Br.	N.	Shrub, 1 m. or less, erect or spreading	Hollows in *Atriplex paludosum* consocies; bare rubble with water at some depth
Chenopodium sp. *(affin., microphyllum)*	Th.	Herbaceous mat plant	Sea cliff; travertine plateau
Atriplex cinereum, Poir.	Ch.	Prostrate, half shrubby	Travertine plateaux; littoral
A. paludosum, R. Br.	N.	Erect bushy shrub	*Atriplex paludosum* consocies
Enchylaena tomentosa, R. Br.	N.	Sémi-prostrate and dense or scrambling shrub, leaves succulent	Travertine plateaux; sea cliffs
Threlkeldia diffusa, R. Br.	Ch.	Succulent leaved mat plant	„ „ „
Arthrocnemum halocnemoides, Nees, var. *pergranulatum*, J. M. B.	N.	Divaricating succulent low shrub, ·5 m.	Cliffs near sea; salt basins in granite at about 200 feet altitude
Salicornia australis, Sol.	Ch.	Prostrate, half shrubby	Near sea
Suaeda australis, Moq.	Ch.	Succulent, mat plant, base woody	Cliffs near sea, spray washed

Name.	Raunkaier's Class.	Habit.	Community.
AIZOACEAE.			
Tetragonia implexicoma, Hook.	N.	Scrambling weak shrub, leaves succulent with small epidermal bladders, 2 to 2·5 x ·2 to ·4 cms.	Mixed scrub; travertine cliffs
Mesembryanthemum acquilaterale, Haw. ..	Ch.	Mat plant with very succulent erect leaves, 7 to 8 cms.	Early colonist of rubble, not halophytic
M. australe, Sol.	Ch.	As above, leaves often coloured orange or red, 1 to 2·5 cms.	Travertine plateaux; sea cliffs
CARYOPHYLLACEAE.			
Scleranthus pungens, R. Br.	Ch.	Cushion plant, up to 50 cms. diameter	*Pelargonium-Mesembryanthemum-Poa* associes; cliffs and exposed slopes
CRUCIFERAE.			
Lepidium foliosum, Desv.	Th.	Erect branching annual, up to 1 m. high ..	Travertine plateau; *Olearia-Leucopogon* associes
GERANIACEAE.			
Pelargonium australe, Willd.	Ch	Low fleshy stemmed, velvety hairy, especially underside leaves	Early colonist of rubble
ZYGOPHYLLACEAE.			
Nitraria Schoeberi, L.	N.	Fleshy leaved shrub under 1·5 m.	Travertine cliffs
RUTACEAE.			
Correa speciosa, Andrews	N.	Shrub up to 1 m., leaves ovate 2 to 2·5 x 1 to 1·8 cms., tough, tomentose below	*Olearia-Leucopogon* associes
SAPINDACEAE.			
Dodonaea viscosa, L.	N.	Erect shrub up to 2 m., leaves 4 to 5 x 1 cms., thin, tough, sticky lacquered	*Melaleuca parviflora* scrub
RHAMNACEAE.			
Spyridium eriocephalum, Fenzl.	N.	Low, peely branching shrub, ·5 m., leaves ·6 to 1·2 x ·15 cms., revolute	*Casuarina stricta* associes *Melaleuca parviflora* scrub
MALVACEAE.			
Lavatera plebeja, Sims, var. *tomentosa*, Hook.	Th.	Erect annual, 40 cms.	Rubble and sand
FRANKENIACEAE.			
Frankenia pauciflora, D.C.	Ch.	Semi-prostrate shrub, leaves up to 1 cm., linear, revolute	Travertine plateau; blown sand
THYMELIACEAE.			
Pimelia serpyllifolia, R. Br.	N.	Erect shrub, 1 m., densely branching, leaves ovate-oblong ·6 to ·8 x ·2 to ·4 cms.	*Melaleuca parviflora* scrub

Name.	Raunkaier's Class.	Habit.	Community.
MYRTACEAE.			
Melaleuca parviflora, Lindl.	M.	Small tree, dense canopy, leaves linear, ·6 to ·8 cms., bark rough	Lower hill slopes, scrub woodland; fresh watercourses
M. halmaturorum, F. v. M.	M.	Small tree, dense canopy, leaves linear, ·6 to ·8 cms., bark papery	Brackish watercourse
Calythrix tetragona, Labill.	N.	Erect shrub, leaves linear, ·8 x ·1 cms.	*Casuarina stricta* consocies
UMBELLIFERAE.			
Apium prostratum, Labill.	Th.	Prostrate herb forming dense mat	Travertine plateau
Didiscus pusillus, F. v. M.	Th.	Erect small herb	*Casuarina stricta* consocies
EPACRIDACEAE.			
Leucopogon Richei, Labill.	N.	Bushy shrub up to ·5 m., leaves ovate lanceolate ·8 to 1 x ·2 cms.	Shrub community; undershrub in *Casuarina* woodland
LABIATAE.			
Westringia rigida, R. Br., var. *dolichophylla*, Ostenf.	N.	Erect branching shrub, 70 cms., leaves linear 2 x ·15 cms., somewhat revolute	*Melaleuca parviflora* scrub
SOLANACEAE.			
Lycium australe, F. v. M.	N.	Erect bushy shrub, branches spinescent, leaves on dwarf shoots 1 to 1·5 x ·2 to ·5 cms., many shed in dry season	Saltbush community on travertine plateau
Nicotiana suaveolens, Lehm.	Th.	Rosette plant	Rubble or sand
MYOPORACEAE.			
Myoporum insulare, R. Br.	N.	Spreading bush up to 1·5 m., leaves 8-10 cms., fleshy	*Olearia-Leucopogon* associes
M. deserti, A. Cunn.	N.	Erect shrub, 70 cms., leaves 2 to 4 cms., prominently glandular	*Melaleuca parviflora* scrub
COMPOSITAE.			
Olearia ramulosa, Labill.	N.	Erect bushy shrub, up to 1·5 m., leaves ·8 to 1 x ·1 cms., revolute woolly below	Shrub community
Cotula coronopifolia, L.	Th.	Small herb	Swampy fresh watercourses
Ixiolaena supina, F. v. M.	Ch.	Prostrate, half shrub, old leaves fleshy	Sea cliffs
Cassinia spectabilis, R. Br.	Ch.	Erect robust herb, leaves lanceolate 3 to 10 x 1 to 3 cms.	*Casuarina stricta* consocies
Calocephalus Brownii, F. v. M.	N.	Divaricating shrub, white tomentum, leaves 3 mm. erect	Sea cliffs
Senecio lautus, Sol.	Th.	Erect branching herb	Travertine sandy rubble
S. Cunninghamii, D.C.	Ch.	Erect branching herb, woody base, leaves 8 to 12 x ·8 to 1·2 cms.	*Casuarina stricta* consocies
Sonchus asper, All., var. *littoralis*, J. M. B.	Th.	Fleshy-leaved herb	Sandy rubble near shore

DESCRIPTION OF PLATES.

Plate IV.

Fig. 1. View of East Hill looking east along the col from the slope of 781 Hill. The north face (left) has a shrub flora and much bare rock, while the south face has a covering of low trees of *Casuarina stricta* and *Melaleuca parviflora*. The trees in the foreground are Casuarinas.

Fig. 2. 781 Hill from south looking across a granite basin at the head of Main Creek. The vegetation in the foreground is *Arthrocnemum halocnemoides*, var. *pergranulatum*, and *Mesembryanthemum australe*. Immediately behind the basin are prostrate trees of *Melaleuca halmaturorum*. Beyond is a scrub woodland of *Melaleuca parviflora*, passing into *Casuarina stricta* woodland about half-way to the summit. The slopes of 781 Hill show the characteristic areas of bare granite.

Plate V.

Fig. 1. *Casuarina stricta* woodland with undergrowth of *Leucopogon Richei*. To the right is the edge of one of the bare granite areas. South face of 781 Hill.

Fig. 2. Summit of East Hill from the north side of col. *Casuarina stricta* on summit amongst granite tors, with *Melaleuca parviflora*, *Olearia ramulosa*, and *Leucopogon Richei* as shrubs. The Casuarinas disappear about the level of the large tor right of the middle. The shrubs in the foreground are *Rhagodia crassifolia*.

Plate VI.

Fig. 1. *Atriplex paludosum* consocies on rubble plain, showing in middle distance sharp junction with community composed of *Rhagodia crassifolia* at the base of a steep rise. About the level of the granite boulders *Rhagodia* is replaced by the *Olearia-Leucopogon* thicket community. On the skyline a few trees of *Casuarina* and *Melaleuca parviflora*. South slope of East Hill, Northern Pearson.

Fig. 2. *Atriplex paludosum* consocies in foreground; behind is the lower course of Main Creek, with a dense scrub of *Melaleuca halmaturorum*, the "paper bark" of which makes the trunks appear white. In the background is the south-east face of 781 Hill, with scrub woodland of *Melaleuca parviflora* on the lower slopes and *Casuarina stricta* in the upper part. Note the large areas of bare granite on 781 Hill.

Plate VII.

Fig. 1. *Atriplex paludosum* consocies on rubble plain with local patches of *Rhagodia crassifolia* (darker-coloured foliage) in hollows. Beyond is the course of Main Creek, with *Melaleuca halmaturorum* intersecting a scrub in which *Melaleuca parviflora* is dominant. The tors on the skyline, right, are at the south-west corner of Northern Pearson.

Fig. 2. *Melaleuca parviflora* scrub and *Atriplex paludosum* consocies junction on north bank of Main Creek. Note the patches of *Mesembryanthemum acquilaterale* with *Pelargonium australe*, the first colonists of granite rubble in the scrub woodland series.

Plate VIII.

Fig. 1. *Atriplex cinereum* on shore forming mounds of blown sand. Behind *Frankenia pauciflora*, dark leaves, also holds sand. Higher up the slope mixed communities, including *Lepidium foliosum* and *Olearia ramulosa*. In right hand corner portions of two hair seals *(Arctocephalus fosteri)* can be seen.

Fig. 2. Foreground travertine plateau flora on Southern Pearson; plants, *Atriplex cinereum*, *Mesembryanthemum australe*, *Threlkeldia*, *Enchylaena*, etc. Middle Pearson, with the landing place seen behind—note the abrupt (south-west) face and gentle slope of the east side. The travertine plateau of this island is well seen. To the right is the south-west coast of Northern Island, with 781 and North Hills.

Plate IX.

Fig. 1. Annual plants *(Senecio lautus* and *Apium prostratum)* now dead and *Enchylaena tomentosa* on travertine plateau of Middle Pearson. Behind Junction of talus slope with *Olearia-Leucopogon* thicket on boulder slope.

Fig. 2. Foreground *Atriplex paludosum* on talus slope to North Bay, Northern Pearson. A watercourse runs from right to left marked by occasional bushes of *Melaleuca parviflora*. This watercourse (North Creek) is fresh. Beyond is bare talus with large spreading bushes of *Rhagodia crassifolia*. The rocky slope behind has an open shrubby flora, chiefly *Olearia ramulosa*, *Rhagodia baccata*, with some *Leucopogon Richei*, *Correa speciosa*, *Mesem. acquilaterale*, and *Pelargonium* on exposed parts with *Scleranthus pungens* and *Poa*.